AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 186

THE D.H.85 "LEOPARD MOTH" AIRPLANE (BRITISH)

A Three-Seat Cabin High-Wing Monoplane

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THE D.H.85 "LEOPARD MOTH" AIRPLANE (BRITISH)*

A Three-Seat Cabin High-Wing Monoplane

The "Leopard Moth", produced by the De Havilland Aircraft Co., Ltd., cruises at two miles a minute with a fuel consumption of less than six gallons an hour, which works out at better than 20 miles to the gallon; and its Gipsy Major engine runs on ordinary gasoline.

In spite of this performance, the cabin is in no way cramped and the passengers sit side by side. This placing, and the quietness of the cabin, makes for normal conversation.

The "Leopard Moth" D.H.85 made its first public appearance in the race for the King's Cup last summer. Three of the type, all with standard Gipsy Major engines, were entered. That flown by Captain Geoffrey de Havilland himself won the race at 139.5 m.p.h., and the other two came in third and sixth with average speeds of 138.5 and 136.1 m.p.h. The total length of the race was 830 miles, and the engines were run at 2,400 r.p.m. the whole time without trouble of any kind.

Since then the De Havilland company have been putting the new type through continuous and searching tests.

Superficially the "Leopard Moth" resembles the "Puss Moth" which it replaces by virtue of its better performance. But the difference can be readily detected. The wings are smaller, have a marked taper, and are swept back. Their form allows a more economic use of material and although built to higher factors of safety than those of the "Puss Moth", they are only slightly heavier.

The "Leopard Moth" has a factor of 7 for the center of pressure forward, or stalling case, and 5.5 for the c.p. back, or high-speed case. The figures for the "Puss Moth" are 5.5 and 4.

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*From The Aeroplane, November 1, 1933.

To reduce resistance the joints between the struts and the wings have been faired and all the aileron operating mechanism hidden in the wing. This has been done by mounting the usual D.H. differential mechanism on the web of the rear spar so that the sprocket revolves in a vertical plane. The push-pull rod runs from the lower part of the sprocket to the upper flange of the aileron spar.

The main features of the wing are box spars, rigid diagonal bracing in the inner bays, and plywood covering between the spars on the under surface of the wings out to the strut joints.

A new form of diamond bracing is used in the center section, which consists of two fore-and-aft members built up of spruce and plywood, a steel tube between the front spar fitting and a wooden member between the rear spar fittings.

Unlike the "Puss Moth" the "Leopard" has a wooden fuselage. And from their experience with "Moths", "Fox Moths," and "Dragons" all over the world, the De Havilland company claim that this form of construction is definitely lighter, more robust, simpler to inspect, and easier to repair than a structure of metal tube. The wooden fuselage may also account for the quietness of the cabin.

An obvious difference is the wire-braced tail unit. Not so obvious is the irreversible screw-jack, tail-adjusting mechanism under the front spar.

The altered landing gear is also obvious. The shock-absorber legs now run to the metal portion of the fuselage just below the windshield. An ingenious system of bevel gears on the tops of these legs replaces the former arrangement of levers for working the air brakes.

The Gipsy Major engine is standard in the "Leopard Moth". It will run for 750 hours, or 90,000 miles, in the "Leopard Moth", between overhauls.

To reduce drag the oil tank has been placed athwart the fuselage in a tunnel behind the fireproof bulkhead through which cooling air is deflected by a scoop.

The cabin holds three people but, unlike the "Puss Moth", the "Leopard Moth" has a seat wide enough for the two passengers right across the back of the cabin with an

adjustable headrest. The latter folds forward to open the luggage space, which measures 3 ft. by 1 ft. 6 in. by 2 ft. 4 in. deep, below the hatrack, which can be folded out of the way. There are straps to hold a couple of golf bags in place.

The "Leopard Moth" is not normally provided with full dual control, but a second control column is supplied for use when the pilot wishes to study maps or the like. The D.H. company considers that full dual control is seldom required in a cabin airplane, and if a rudder bar is fitted for a passenger the comfortable foot rests have to be taken out. But if "Leopard Moths" are wanted for instruction the passenger's rudder bar and necessary mechanism can be supplied. The ends of the second rudder bar then stick out on each side of the pilot's seat.

Gray leather is used as the standard upholstery, and with gray carpets to match and a polished gray walnut instrument board, it looks very pleasant.

The standard color scheme for the outside is aluminum for the wings and tail unit and any single color (except white or gold) for the fuselage, struts, landing gear, and registration letters on the wing.

SPECIFICATION

Type.- Three-seat cabin monoplane.

Wings.- High-wing braced monoplane. Dihedral 0 deg. 45 min. Sweepback 6 deg. 38 min. Incidence 2 deg. 30 min. Chord: at root 7 ft. 1-1/4 in., at tip 3 ft. 10 in. Wings, attached to diamond-braced center section forming roof of cabin, are braced by V-struts and fold about rear spar hinges after trailing-edge flaps have been folded up. Wooden structure with built-up box spars (fig. 3). Stout spruce diagonals form internal bracing of inner bays with normal wire bracing in two outer panels. Closely spaced built-up wooden ribs. Plywood covering over nose and on under side of wings between spars out to strut joints. Remainder covered with fabric. Differential ailerons with all gear inside wing. Built-up spar and diagonally placed ribs covered with plywood. External mass balance.

Fuselage.- Forward portion to door pillars of welded steel tube, remainder wooden box structure with spruce members and plywood covering. Roof of cabin forms center section of wing.

Tail unit.- Monoplane type with wire bracing between fin, stabilizer and fuselage. Balanced rudder. Unbalanced elevators. Stabilizer hinges about rear spar with irreversible screw-jack incidence-adjusting gear under front spar. Wooden structure throughout. Fin and stabilizer covered with plywood, rudder, and elevators with fabric.

Landing gear.- Divided type. Half axles and radius rods hinged to center line beneath fuselage. Shock absorbers incorporating rubber in compression run up to fuselage at base of windshield. Fairing on these can be rotated through 90 degrees by bevel gearing at end to form air brake. Dunlop low-pressure wheels. Bendix brakes with differential control. Fully castoring tail wheel with rubber-in-compression springing (figs. 4 and 5).

Power plant.- One 130 hp. D.H. Gipsy Major 4-cylinder in-line inverted air-cooled engine on vibration damping attachments on welded steel-tube engine mounting attached at four points to fuselage. One 17½-gallon (79½-liter) fuel tank in each wing root feeding by gravity. Oil tank of 2 gallons (9 liters) behind fireproof bulkhead with air scoop to deflect air past it.

Accommodation.- Enclosed cabin for three (figs. 6 and 7). Pilot sits in front with passengers side by side behind on seat right across cabin with adjustable headrest. Door down to floor on each side. Full range of instruments including air log and Reid and Sigrist turn-and-bank indicator in gray walnut dash. Adjustable foot rests for passengers and high straps for all. Pilot's locker between rudder-bar bearers. Pockets in both doors. Two lockers under seat at back. Luggage space 3 ft. by 1 ft. 6 in. by 2 ft. 4 in. deep behind seats with straps to secure golf bag each side. Hatrack. Gray antique leather upholstery throughout. Gray floor carpets. Controllable hot or cold ventilation.

Controls.- Normal control column and rudder bar with adjustable compensating device (fig. 8). Dual control can be fitted if desired. Tail-adjusting wheel on left beneath engine controls. Air-brake lever on right. Wheel brake on

left door, differential control through rudder bar. Fuel cocks in cabin walls close to rear spar joints. Fuel pipes unite beneath cabin floor and single pipe runs forward to engine. All control rods, levers, and wires are beneath cabin floor and can be inspected from outside by undoing zip-fastened inspection panel.

CHARACTERISTICS

Dimensions:

Span	11.43	m	37 ft.	6 in.
Width (wings folded)	3.81	"	12 "	6 "
Length (over-all)	7.47	"	24 "	6 "
" (folded)	8.08	"	26 "	6 "
Height	2.67	"	8 "	9 "
Wing area (including center section and ailerons)	19.12	m^2	206.00	sq.ft.

Weights and loadings:

Airplane empty (including standard removable equipment)	608	kg	1,340	lb.
Pilot	73	"	160	"
Fuel and oil (for 715 miles)	128	"	283	"
2 passengers	145	"	320	"
Luggage	55	"	122	"
Airplane loaded	1,010	"	2,225	"
Acrobatic C. of A.	794	"	1,750	"
Wing loading	52.7	kg/m^2	10.8	lb./sq.ft.

Performance (at 2,225 lb.):

Maximum speed at sea level	225.3	km/h	140	mi./hr.
Cruising speed at 305 m (1,000 ft.)	191.5	"	119	"
Fuel consumption at cruising speed	22.3	liters/h	5.9	gal./hr.
Stalling speed (indicated)	80.5	km/h	50	mi./hr.
Take-off run	196	m	215	yards
Time to take off	17	seconds		
Landing run (brakes on)	128	m	140	yards
Gliding angle (air brake on)	1 : 9			
Gliding angle (air brakes off)	1 : 12			
Initial rate of climb	3.17	m/s	625	ft./min.
Time of climb to 1,525 m (5,000 ft.)	9.5	minutes		
Time of climb to 3,050 m (10,000 ft.)	23.5	"		
Absolute ceiling	5,280	m	17,300	ft.
Service "	4,420	"	14,500	"
Range	1,138	km	707	miles

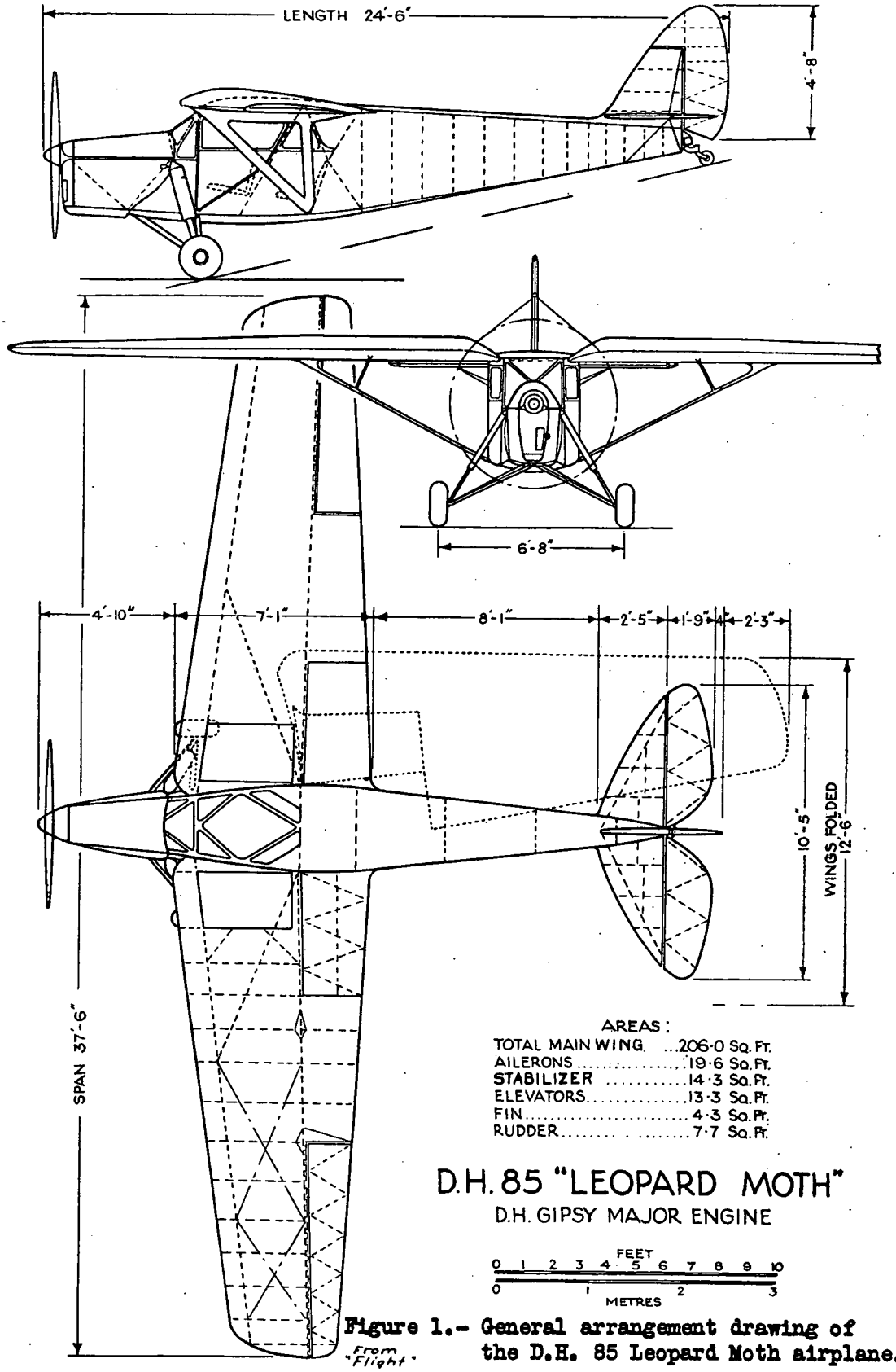


Figure 1.- General arrangement drawing of the D.H. 85 Leopard Moth airplane.

Figure 2.- View of the D.H.85 Leopard Moth with a Gipsy-Major engine

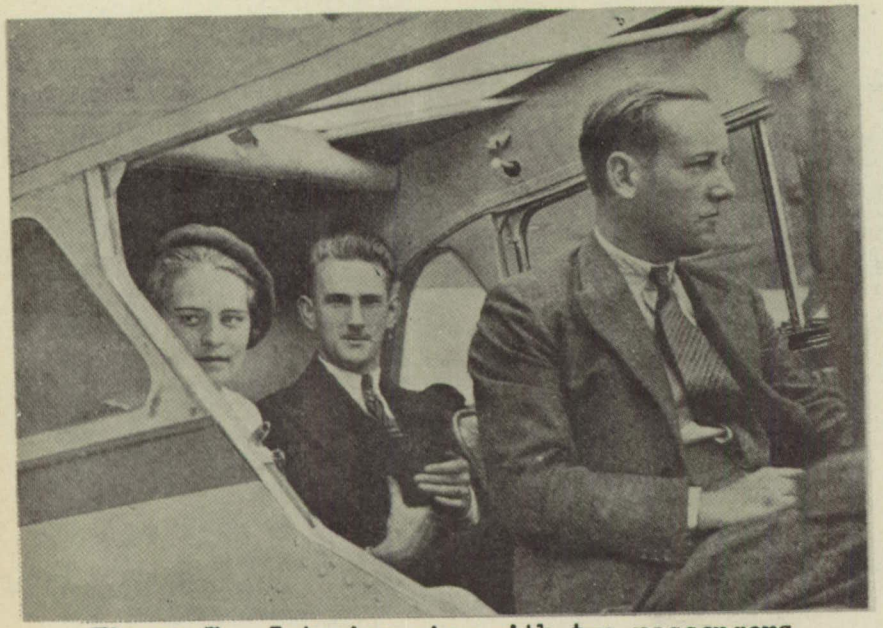
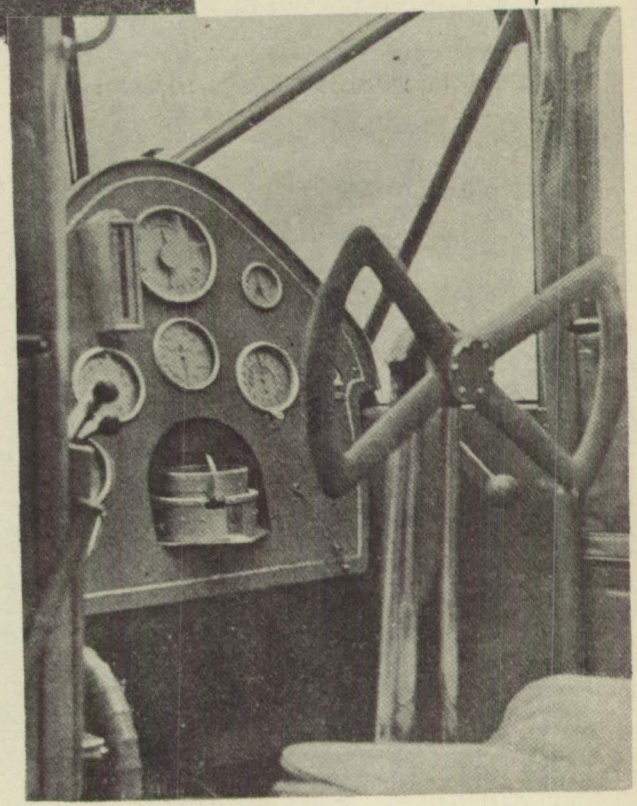


Figure 7.- Interior view with two passengers and pilot

Figure 8.- Spectacles instead of a control-stick, can be fitted as an extra in the Leopard Moth D.H.85



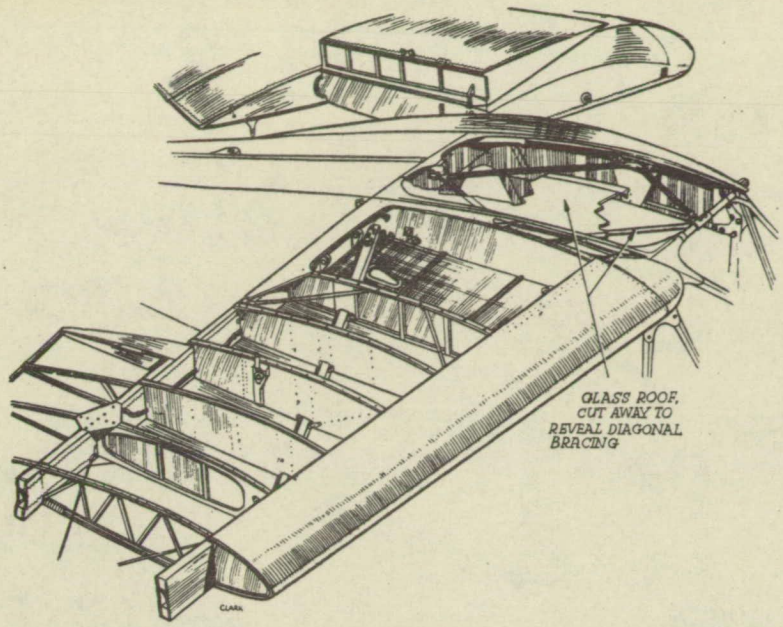


Figure 3.- The wings and center section of the D.H.85 Leopard Moth airplane

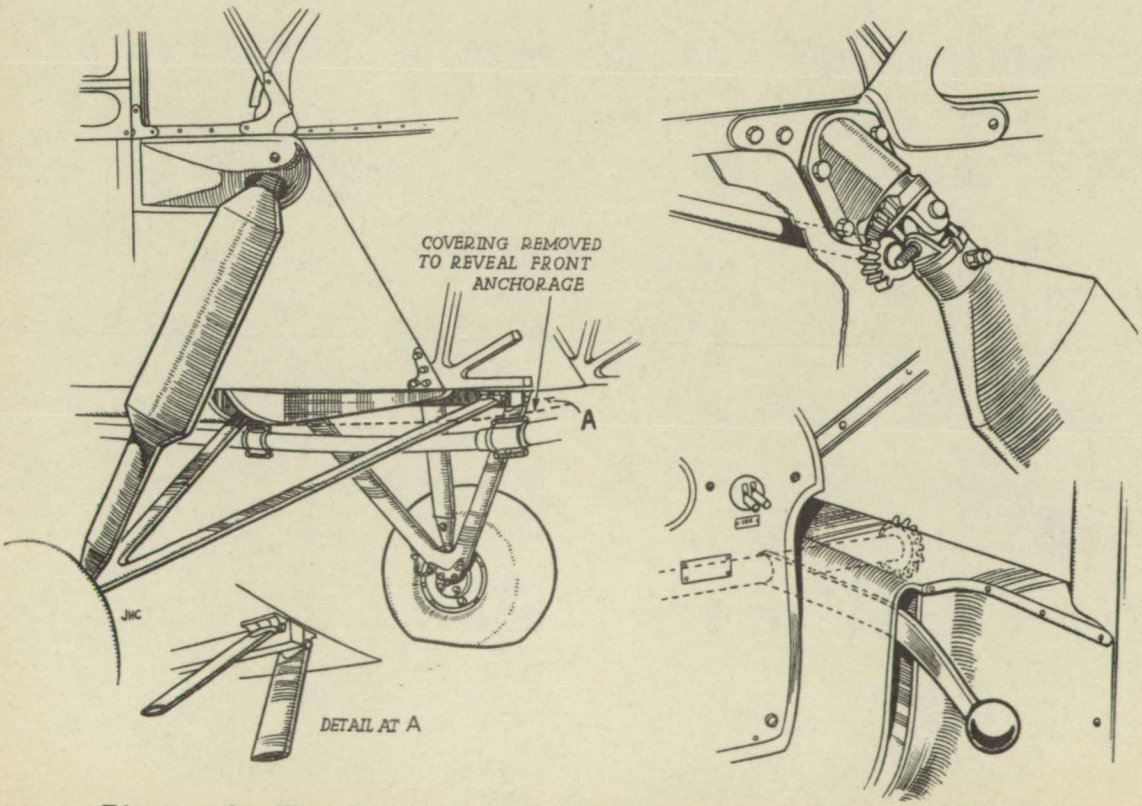


Figure 4.- The landing gear of the D.H.85 Leopard Moth airplane showing the air brake mechanism

Figure 5.-The Leopard Moth D.H.85 tail wheel which castors for a full circle turn, independent of the spring buffer above.

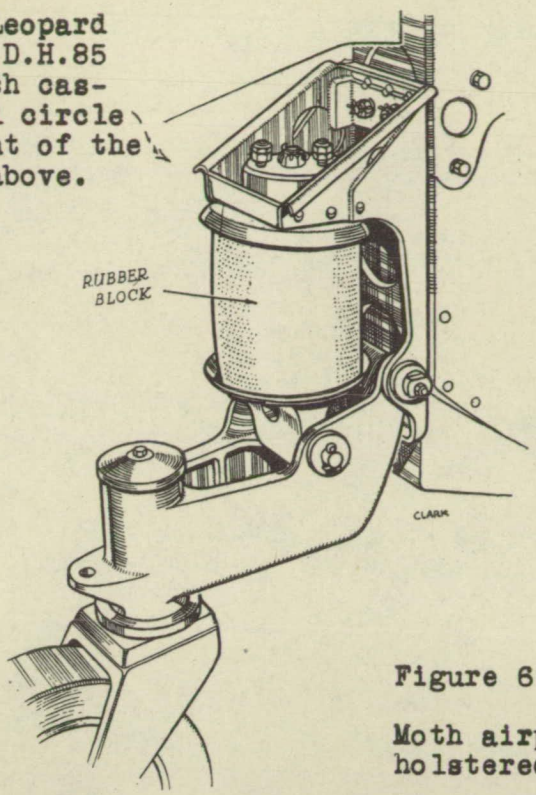


Figure 6.-The cabin of the D.H.85 Leopard Moth airplane, which is upholstered in grey leather